The average age at election was 43·9, and the average age of all the Fellows in 1891 was 58·4.

Table III. records the numbers of Ordinary Fellows elected in each year, and remaining alive in each year after election, until 1891.

From this it will be seen that during the last ten years the numbers have increased by 46; in the previous ten years the increase was 68, or 22 more; and in the ten years still earlier the increase was 111, or 43 more than the last. If the decrease of growth for the ten years after 1890 takes place in a similar ratio to that which took place between 1870-80 and 1880-90, we might anticipate an increase of only 11 up to 1900, or probably a smaller number.

In order to obtain a satisfactory comparison between the lives of the Fellows, and those of the general population as shown in the accepted life tables, I have calculated, from the known ages of the Fellows at election, and the known dates of the deaths that have occurred among them, the average age of the Fellows remaining alive in each year. From these ages I have computed, from Dr. Farr's tables, the probable number of Fellows that would survive from year to year, assuming the initial number to be 15.

From Table III., above referred to, has been ascertained the number of Fellows surviving in each successive year after election, and thence has been obtained the average number surviving from an initial number 15.

The results of these computations will be found in Table IV.

The second column in this table shows the number of lives dealt with for each year after election. The first entry, 645, is the total number of Fellows elected in the whole 43 years. The next column to the right gives their aggregate ages, and the next their average age, 44·0, in their first year. Following the same line to the right, we find the average number of Fellows elected, and in their first year.

Passing to the second line of the table, 619, immediately below 645, is the total number of Fellows remaining in their second year from the elections of 42 years; this is succeeded, in the columns to the right, by their aggregate ages in their second year and their average age, and the average number in their second year, out of 15, the average number elected.

The third line gives the same data for the third year of Fellowship, and so on throughout, the last line but one showing that in their 42nd year there remained 6 Fellows from the elections of 2 years, with an aggregate age of 444 years, and an average age of 74·0, the average number surviving in their 42nd year, out of the 15 elected, being 3.

The sixth column of the table gives the successive sums of the numbers in the fifth column, and therefore indicates the aggregate number of Fellows that will, on the average, be surviving in each successive year of Fellowship, the number elected in each year being always supposed to be 15.

It will be seen that the total for the 43rd year is 397·0, whereas the actual number surviving, shown in column XI., is 401. This difference is of course due to the number 397 representing what the result would be if the average rates of election and decrease prevailed, instead of the actual rates for the separate years; and it is probably sufficiently accounted for by the fact, already pointed out, of the gradually increasing age at election in the later years, which will lead to the lives in the earlier years of the series being somewhat better than the average. Column XI. shows the *actual* results for successive years corresponding to the average results given in column VI. The differences will be seen to be somewhat irregular, but nowhere to be of importance.

Column VII. gives the aggregate ages of the numbers surviving in successive years, as shown in column V., and from it is deduced the average age of the whole number of Fellows shown in column VI., 397, which is seen to be 57·7 years, a result differing slightly from that obtained from the actual ages of the Fellows surviving in 1891, which was shown to be 58·4. The cause of this difference has already been indicated.

Columns VIII. and IX. supply the results that would be obtained by applying to an initial number of 15, the rates of mortality in Dr. Farr's tables, for the ages in successive years given in column IV. Column X. contains the ratio of column VI. to column IX., and indicates that throughout the whole period of 43 years the actual results are somewhat better than the tabular results, or that the lives of the Fellows are better than the ordinary lives, and that this advantage leads in the 43rd year to the actual number of survivors being rather more than 5 per cent. in excess of that which would be given by the life tables, or of about 20 on a total of 400.

An examination of this table will show that, with the exception of the last six or eight years, in which the number of lives dealt with at last becomes very small, the figures indicate a very regular and consistent progression, and it will practically be quite safe to assume that the series in column VI. may be extended on the basis of the ordinary life tables, subject to the addition of 5 per cent. on the total amounts obtained from these last.

Hence it will be found that in 10 years after 1891 the aggregate number of Fellows is not at all likely to be increased by more than 15, that the final result may be as little as 410, but is not likely to be more than 420, or at the outside 425.

In an earlier part of this paper, I mentioned that the rate of decrease of the Ordinary Fellows elected before 1848 did not appear to differ materially from that which has prevailed subsequently.

Taking the number of Ordinary Fellows elected before 1848, and then alive, at 718, it will be found that in 12 years (1860) the number was reduced to 422, which is about 60 per cent. of the original number; after 24 years (1872) the number fell to 206, which is about 30 per cent. of the original; and in 36 years (1884) there remained only 65, which is about 9 per cent. of the first number.

Assuming that the average age of the 718 Fellows elected before 1848, and then alive, was not materially different from (58) the average age of the Fellows elected after 1848 and alive in 1891, when it has probably become nearly stationary, it may be inferred that the lapses among a body of Fellows of that age will correspond to the lapses among the Fellows alive in 1848. Now, from Table IV. it will be seen that of the Fellows elected after 1848, the average age in their 17th year was 58·3 years, which is almost exactly the average age of the whole body. Further, it is shown that of the supposed original 15 there remained 10·9 in the 17th year of the age above mentioned, 58·3. This number was reduced in 12 years to 6·7, which is nearly 60 per cent. of the number in the 17th year, and again falls after 12 years more to 3·7, which is not very different from 30 per cent. of the starting number, and after 12 years more the number will be seen to be likely to be less than 1·0, which again will not differ materially from 9 per cent. of the original 10·9. These proportions, it will have been observed, are those above shown to hold in the case of the Fellows elected before 1848.

On the whole, it seems to be established that the present restriction to 15 of the number of Ordinary Fellows elected in any year will lead to an eventual maximum number not exceeding 420; and that the ultimate increase of the total strength of the Society, for each additional Fellow elected in excess of 15 may be taken at 28, so that an increase to 18 of the annual number of Ordinary Fellows elected would lead to an ultimate total of 500 such Fellows.

THE ERUPTIONS OF VULCANO (AUGUST 3, 1888, TO MARCH 22, 1890).[1]

THERE are some 180 (nominally 212) pages and 11 plates. Of these latter 4 are reproductions of Silvestri's beautiful whole-plate photographs [one of Vulcano at rest (with Vulcanello), and the other three instantaneous views of the volcano in eruption]. A fifth reproduces, half-size, two of Dr. Johnston-Lavis's instantaneous views of eruptions taken from the crater's edge.[2] Two other plates give 14 excellent photographs of the "bombs," and of the rest two are sketches of Stromboli crater, one petrographical, and the last the map of Vulcano (1/50,000).

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[1] "Le Eruzione dell' Isola di Vulcano, incominciate il 3 agosto, 1888, e terminate il 22 Marzo, 1890: Relazione scientifica della Commissione incaricata degli studi dal R. Governo," *Annali dell' Ufficio Centrale di Meteorologica e Geodinamica*, Parte 4, vol. x., 1888 (Rome, 1891).

The Commission was originally as follows:—President, Prof. O. Silvestri (Catania), Prof. G. Mercalli (Milan), Prof. Grablovitz (Seismological Observatory, Ischia), and as engineer, V. Clerici (Messina), with A. Cerati, Prof. Ponte, and A. Silvestri, as assistants.

As is known, Prof. Silvestri died before the publication of the Report, but not till some months after the end of the eruptions, on which he had elsewhere published various papers. The Commission must thus have had full time to profit by his experience both in the field and afterwards, and his name appears as author or joint author of a number of sections. After Silvestri's death, Prof. Mercalli, the largest contributor to this Report, took his place, and brought the work to its completion.

[2] For others by Dr. Lavis and Silvestri, see "South Italian Volcanoes."

A table of contents may be found at the end.

Appended to the various sections are the names of the authors responsible. The 180 pages of text necessarily vary in character. Thus, 50 pages are devoted to an almost daily record of the state of the volcano during the twenty months of the eruption. For not a few days we have a record of the times and degree of violence of all the explosions which (February 12 and 14, 1889) might number more than 100 between 10 a.m. and 6 p.m. On the other hand, we find between pp. 207 and 210, a *résumé* of the chief facts observed, and the conclusions to which they point.

There are 20 pages (9–29) on the topography and geology of the island of Vulcano. Details are given as to the rocks collected at various localities, and the conclusion (expressed with some reserve) as to the history of the island, is very similar to the view stated (Proc. Geol. Assoc., vol. xi. pp. 395-96, 1890) by Dr. Johnston-Lavis.

The author (Mercalli) only recognizes one crater (with lavas of andesitic and basaltic type) in the "Piano" district, which forms the southern half of the island. The Serro di Capo and Monte Lentia represent the western part of a second old (north-west) crater of more "acid" type, which may have had its centre almost coincident with that of the present active cone, and which, judging by the weathering of the rocks, may be older than the Piano crater. The author notices that the straight north and south line, drawn from *Vulcanello* through the *hot springs* by the "Faraglioni" and the two overlapping "*Forgia Vecchia*"-*s* (on the north flank of Vulcano) to the present crater (or "*Fossa di Vulcano*"), if continued, strikes *Monte Saraceno* (a lateral cone on the north-west edge of the Piano crater). It is then pointed out that, assuming Monte Saraceno to be situated over a continuation of the crack which most probably runs from Vulcano to Vulcanello, and assuming the present eruptive centre to coincide with that of the old north-west crater, that then the present "Fossa di Vulcano" is situated on the point of meeting of two cracks, viz. a north to south one from Vulcanello to Monte Saraceno, and a north-west to south-east one joining the more ancient craters. The present crater would then be situated over a weak point. Whether or no Monte Saraceno be situated over a crack extending south from Vulcano rather than over some other, there is nothing at any rate in the above against the view expressed in Prof. Judd's "Volcanoes" (see Fig. 81), according to which there is one main crack beneath the island of Vulcano, the crack from Vulcano to Vulcanello being but a continuation of that on which the more ancient craters lie. As to the number of craters more ancient than the main modern cone, it will be seen that the Report takes a view intermediate between that of Scrope ["Volcanos," 2nd edit., p. 192, Fig. 47] and that of Judd ["Volcanoes," p. 196, and Figs. 77 and 85].

The twenty pages (30–50) devoted to the records of previous eruptions are naturally full of interest. A number of quotations from older writers are given. The conclusion is that the eruptions of Vulcano in the historic period have been on the whole very similar.

As interesting dates may be noticed :—475 B.C., Vulcano in activity (Thucydides); 183 B.C., Vulcanello formed; about 1550 A.D., strait between Vulcanello and Vulcano filled up by eruption of the latter; 1727, Forgia Vecchia (on north slope of Vulcano) in eruption (D'Orville); 1771, "Pietre Cotte" obsidian stream (on north flank of Vulcano) poured out; 1878, Fumaroles still visible on Vulcanello.[1]

From p. 53 to p. 174 is devoted to (1) detailed record of the eruptions, as to which a valuable *résumé* is given, pp. 112–14; (2) seismological and various other physical observations; and (3) the description of the erupted products.

The following epitome is based on that given by Silvestri, pp. 207–208 :—

(*a*) The recent activity of Vulcano lasted 20 months, viz. August 3, 1888, to March 22, 1890 (with final explosions, May 17), the most violent explosions (p. 113) occurring on August 4, 1888, December 26, 1889, and March 15, 1890. There had previously been a period of repose (1832–72), followed by minor premonitory eruptions in 1873–7–8–9 and 1886.

(*b*) Just as we have the "*Plinian*" or "*Vesuvian*" eruptions of Vesuvius accompanied by violent outbursts of "ashes" and welling out of lava, and the incessant, milder "*Strombolian*" type of eruption, so we may distinguish a "*Vulcanian*" type (pp. 58–59). Characteristic of this are—

(i.) Intermittent explosions with discharge of bombs, ash, dust, and vapours. Each of these explosions resembles the first outburst of "Plinian" ("Vesuvian") eruptions (p. 112).

(ii.) The absence of lava streams.

(iii.) The absence of noteworthy earthquake shocks.

(*c*) The more violent of the explosions burst out suddenly, discharging clouds of vapour, with dust lapilli, and more or fewer bombs and fragments of compact lava, and such an explosion was then followed at short intervals by feebler ones, which merely discharged the smaller materials, or vapours only.

(*d*) The more violent explosions were generally separated by longish intervals, either of absolute repose, or with insignificant explosions; and, on the other hand, when eruptions took place every few minutes, they were generally feeble.

(*e*) (p. 113, 70) Observations of atmospheric pressure extending over a day, or short period of time, show no relation to the frequency or degree of violence of the explosions. But viewing the 20 months of the eruption as a whole, it is found that Vulcano enjoyed comparative repose during periods of high atmospheric pressure, or of small change, and was most active during periods of change from fair to stormy weather, with marked fall of barometer.

(*f*) Though during the 20 months of the eruption there were altogether a good many earthquakes recorded either by the seismoscope, or by some of the inhabitants (pp. 134–37), still these were but slight, and, as stated, formed no feature of the eruption, being very rare compared with the explosions.

It was found (pp. 125–28) that for making observations of the shocks or tremors accompanying the explosive eruptions, even close to the foot of Vulcano, seismoscopes were as a rule not sensitive enough. On the other hand, owing to the frequency of the explosions, a tromometer was never quiet. The simplest method is often the best, and recourse was had to pools of mercury (at once sensitive and stable). With the aid of a reflector it was then easy to keep an eye at once on the reflection of some object in the mercury, and on the lip of the crater, and so observe the time relation between the tremors and the explosive outbursts.

Observations made near the base of Vulcano showed that each eruption was preceded by a short tremor (apparently the result of a deep-seated explosion), followed after a short interval of calm, of from a few seconds to three-quarters of a minute, by another, the result, apparently, of the superficial explosion that made a vent for the vaporous and solid ejecta. The interval was shorter in the case of the more violent explosions.

(*g*) In the first three days of the eruption (pp. 54 and 152–58), August 3–5, 1888, the ejecta consisted mainly of a variety of old materials blocking the neck of the volcano. These, much of which was more or less altered by solfataric action, were discharged in pieces of all sizes from fine dust to large masses.[1]

(*h*) After an interval of thirteen days, the second main period of the eruption set in. The older materials soon became almost entirely replaced by newly elaborated matter in the form of dust, lapilli, lighter or heavier "bread-crust" bombs,[2] and masses of compacter lava. These, as opposed to the matter discharged during the first three days, were all, except for inclusions of older rocks, of essentially similar mineralogical and chemical constitution (of andesitic type (p. 165), with 62–67 per cent. of silica, the percentage of which might be greater in the centre than in the crust of the same bomb). The larger masses on leaving the crater had a high initial temperature, and were plastic, taking rounded, elongated, or flattened forms, and on reaching the ground melted various metallic wires—silver (1000° C.), and copper (perhaps 1200°, but, as we are cautioned, the copper might oxidize and then fuse lower).

From the preceding, Silvestri draws the following conclusions :—

(Excluding the ejecta of the first three days) The high temperature and plasticity, with the presence of inclusions of older rocks, and the uniform composition of the ejecta, point to their being derived from a molten magma of recent elaboration. Of this, all things considered, there was probably a vast reservoir at a depth probably far below the bottom of the adjacent sea (which is 670 metres on the east, and 500 metres on the west). At intervals the steam included in this molten lava would acquire sufficient force to burst forth, producing the premonitory tremor (see (*f*) above, and pp. 125-28); and though it is not very clearly stated, I gather that the interval of calm between the first and second tremors is considered to have been occupied by the escape of such steam into the space between the surface of the deep-seated lava and the crater floor, till it acquired sufficient pressure to force an exit through the mouth of the crater (which became plugged by the fall of ejecta after each eruption). Then the visible explosion would take place, accompanied by the second tremor.

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[1] Dr. Lavis found these practically extinct in 1887 (see NATURE, vol. xxxviii. p. 13).

[1] The Report describes these as not so hot as the later ejecta. However, from Mr. Narlian's graphic account (*Times*, September 13, 1888, and Brit. Assoc. Report, 1888, p. 665) it would seem that, at the first outburst, some of the ejecta fell red-hot, so as to set hedges, &c., on fire.

[2] Dr. Lavis, in NATURE, vol. xxxix. p. 110.

The "bread-crust" bombs (with pumiceous interior and cracked subvitreous crust) are said to commonly contain inclusions of older rock, and it is suggested (pp. 163 and 209) that the frothing up of the interior is *in part* due to these, for, says he, fragments of rock falling into a superhydrated molten lava may not improbably act as centres of ebullition, just as solids (in proportion to their extent of surface) cause rapid disengagement of gas when dropped into "soda"—or other aërated—waters.

The compact fragments and masses sometimes ejected (pp. 120, 160, and 209), notably in the last eruption, might be explained as pieces of the shells of domelike bubbles which had partly consolidated below the volcano, or as derived from less hydrated parts of the magma.

If there was this huge lake of lava and so much steam, why did not the lava appear at the surface? Silvestri points out that the rise of the lava will depend on the proportion of the compressed steam to the mass of the lava that contains it, and on the resistance offered to its escape. If the exit of the steam is blocked by lava, we may have all the phenomena of a "Plinian" ("Vesuvian") eruption. On the other hand, in 1888 Etna had eruptions of vapours only, and we get all stages between these two. In the case of a large space partly filled with lava at a great depth, below the surface, the conditions might well be such that the steam would escape long before the lava overflowed.

Among other points dealt with in the Report may be noticed:—Pp. 143-45, the breaking three times during this eruptive period of the submarine cable between Lipari and Milazzo in Sicily. The first and third breaks were near the same spot, and near a place where the sea was seen to "boil," with pumice rising to the surface.

On p. 147 observations are recorded which support the view that the electric discharges accompanying eruptions depend principally on the friction of much dust and fine ejecta. Violent explosions discharging large masses, if unaccompanied by such finer matter, might be without the electric phenomena (p. 146).

There are ten pages on the state of Stromboli during the eruption of Vulcano, from which there appears to have been no relation between the two. Nor do the "secondary phenomena" (the hot springs and fumaroles) in these islands appear to have been markedly affected. Some of the fumaroles increased and some decreased in vigour, and some showed no change.

From what has been said as to the slight seismic effects, we are prepared to hear that no change in the level of the land was produced. In this connection there is a chapter on the tides, which have an amplitude at Lipari of about 30 cm.

On p. 120 are given four sections, in three, of the crater of Vulcano before, during, and after the eruption, from which it is seen that the crater has been much filled up.

On November 18, 1891, the writer found the crater still in the quiet solfatara condition, so that one could descend into it. The higher slopes were covered with white, and the lower, where the fumaroles were more marked, with yellow and red crystalline deposits. A little water lay at the bottom. The deepest part was a funnel-like depression, a little to the north of the middle, somewhat as shown in Mercalli's figure for April 1890. This marked the last eruptive vent.

In conclusion, then, the Report contains a great mass of facts, and in addition generalization and theory, which, as often based on long experience, are also welcome; and the Commission is to be congratulated.

G. W. BUTLER.

SOCIETIES AND ACADEMIES.

LONDON.

Anthropological Institute, May 10.—Dr. Edward B. Tylor, F.R.S., President, in the chair.—The election of the Duke of Devonshire and Dr. H. Colley March was announced.—Mrs. Bishop (Miss Isabella Bird) read a paper on the Ainos of Japan, amongst whom she had spent some time in a village near Volcano Bay. It is doubtful whether the Ainos were the aboriginal inhabitants of Japan; they say themselves that they conquered and exterminated an earlier race who dwelt in caves. The men are strongly built and muscular, and their stature varies from about 5 feet 4 inches to 5 feet 6 inches. The extreme hairiness ascribed to the Ainos applies only to the mountain tribes, and to the men only amongst them; the women, and the men of the coast tribes, not being more hairy than many people of other races. The houses are rectangular and built of wood; they are all constructed on the same plan, and have a large window at the east end opposite the door, and two smaller ones in the south side, below which is the shelf on which the boys of the family sleep; the girls occupy a similar shelf on the north side of the room, and during the night the sleeping-places are screened off by mats. The women are remarkable for their modesty, and the men are exceedingly gentle, obliging, and hospitable. They are a religious people, and offer copious libations of "saki" on the slightest provocation. The race is dying out, and will no doubt be quite extinct in the course of a few generations.

PARIS.

Academy of Sciences, May 24.—M. d'Abbadie in the chair.—Heats of combustion and formation of alcohol and of formic and acetic acids, by MM. Berthelot and Matignon.

$$C_2(\text{diamond}) + H_6 + O = C_2H_6O \left\{ \begin{array}{lr} & \text{Cal.} \\ \text{liquid} \ldots & +69{\cdot}9 \\ \text{gas} \quad \ldots & +59{\cdot}8 \\ \text{solution} & +72{\cdot}4 \end{array} \right.$$

Heat of combustion of liquid alcohol at constant pressure = 324·5 cal.

$$C\ (\text{diamond}) + H_2 + O_2 = CH_2O_2 \left\{ \begin{array}{lr} & \text{Cal.} \\ \text{solid} \quad \ldots & +103{\cdot}3 \\ \text{liquid} \quad \ldots & +100{\cdot}8 \\ \text{gas at } 200^\circ & +\ \ 90{\cdot}0 \end{array} \right.$$

Heat of combustion of liquid formic acid at constant pressure = 62·5 cal.

$$C_2(\text{diamond}) + H_4 + O_2 = C_2H_4O_2 \left\{ \begin{array}{lr} & \text{Cal.} \\ \text{solid} \quad \ldots & +119{\cdot}7 \\ \text{liquid} \quad \ldots & +117{\cdot}2 \\ \text{gas at } 250^\circ & +107{\cdot}1 \end{array} \right.$$

Heat of combustion of liquid acetic acid at constant pressure = 209·4 cal.—Some facts in the chemical history of nickel, by M. P. Schützenberger.—Degradation products of the tissues, particularly of the muscles, separated from the living being: analytical methods, by MM. Armand Gautier and L. Landi.—On the *Bramus*, a new type of fossil rodent from the Quaternary phosphorites of Berberah, by M. A. Pomel.—On the flexure of Gambey's mural circle, by M. Périgaud.—On the appearance of Saturn's ring at the present time, by M. G. Bigourdan. On May 21 M. Bigourdan made some observations of Saturn's ring, with special reference to its thickness. He noted several uneven portions at different points, thus confirming the observations of previous workers.—On integrals in dynamics, by M. P. Painlevé.—On equations in dynamics, by M. R. Liouville.—Approximate equation to the trajectory of a projectile in air when the resistance is supposed to be proportional to the fourth power of the velocity, by M. de Sparre.—Experimental researches on the *matériel de la batellerie*, by M. F. B. de Mas.—On the characteristic equation of various vapours, by M. Ch. Antoine.—The two phases of the persistence of luminous impressions, by M. Aug. Charpentier.—Plastic sulphur formed from sulphur vapour, by M. Jules Gal.—Some basic nitrates, by MM. G. Rousseau and G. Tite.—On the preparation and properties of arsenic cyanide, by M. E. Guenez.—Occurrence of fluorine in modern and fossil bones, by M. Ad. Carnot.—Apocinchonine and diapocinchonine, by MM. E. Jungfleisch and E. Léger.—Monosodium pyrocatechol, by M. de Forcrand.—Substitution reactions in carbon or nitrogen nuclei: application to explosive compounds, by M. C. Matignon.—On dibromomalonic acid, by M. G. Massol. The heats of neutralization by each successive KOH are about 10 cal. superior to those of malonic acid. The general conclusion is drawn that the sub-